

Application No. 10/070,123

Filed: March 29, 2002

TC Art Unit: 1764

Confirmation No.: 9685

REMARKS**1. Priority**

Examiner has noted that a certified copy of the JP2000-202305 application was not submitted by applicant. Applicant respectfully submits that this application was filed in Japan to the PCT and entered the U.S. national phase from the PCT. Therefore, the International Bureau should have provided the certified copy of the priority document to the U.S. PTO.

**2. Specification**

The Abstract has been amended to an appropriate form and length.

**3. Claim Rejections Under 35 USC 102**

Examiner rejected claim 1 as being anticipated by Sugitani et al., U.S. Patent No. 5,316,721. Applicant has canceled claim 1.

**4. Claim Rejections Under 35 USC 102 and 103**

Examiner rejected claim 2 as being anticipated by or, in the alternative, as obvious over Sugitani et al. Applicant has canceled claim 2.

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5. Claim Rejections Under 35 USC 103

Examiner rejected claims 2, 3 and 6-9 as being "unpatentable over in view of Konoki et al., U.S. Patent No. 4,444,732."

Applicant has canceled claim 2, 6 and 8. Applicant has amended claim 3 to further distinguish the present invention from the cited references. Claims 7 and 9, which depend from claim 3, have been amended grammatically, without change in meaning.

In distinguishing the present invention from the cited references, it is important to note that one of the goals and achievements of the present invention concerns a specific degradation in the metallic materials used in a fuel reformer tube undergoing temperature exposure of 700-800 degrees Celsius, more specifically a degradation phenomenon called sigma brittleness (see Specification page 2, lines 9-14). Another goal of the invention is to improve durability and resistance to corrosion in the presence of high heat (page 1, lines 21-25; page 3, lines 31-34; page 7, lines 12-14). A further objective and achievement of the present invention is to provide a lightweight, low-cost, highly reliable and durable fuel reformer [...] without increasing the wall thickness of the reformer [...]" (Specification, page 31, lines 31-34; page 32, lines 1-3). The Applicant solves these problems and achieves these goals with a material composition that

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includes at least chromium (Cr), nickel (Ni), silicon (Si) and niobium (Nb), by Cr 17 to 20 mass %, Ni 8 to 14 mass %, Si 2 to 4 mass %, Nb 0.05 to 0.5 mass %, and the remaining ingredients include iron (Fe) and inevitable impurities (carbon, manganese, phosphorus, sulfur or others).

With respect to Sugitani: Sugitani teaches an alloy consisting essentially of, in % by weight, more than 20% to less than 30% of Cr, more than 25% to less than 40% of Ni, more than 2% to less than 3% of Si and more than 0.6% to less than 2% of aluminum (Al) (claim 1 of Sugitani) and 0.2% inclusive to 2.0% inclusive of Nb (claim 2 of Sugitani). The amounts of Cr and Ni in claim 3 of the present invention are different from those of Sugitani et al.

With respect to Konoki: Konoki discloses a reactor tube having an inner-wall, reacting layer and an outer covering layer, wherein, in terms of % by weight (wt%), the reacting layer comprises up to 3 wt% Si, 20 to 30 wt% Cr, up to 3 wt% Nb, either zero wt% Ni or containing a small wt% Ni in the presence of a significant wt% manganese (Mn), and the covering layer comprising up to 2.5% Si, 20-30% Cr and 18-40% Ni and silent about Nb (claim 1 and Col. 2, lines 13-27).

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Konoki et al., identifies a problem of "deterioration of tube material due to carburizing through reaction wall surface, [...] cracks due to embrittling of tube material under high pressures." However, Konoki et al. solve this problem in a manner that teaches away from Applicant's invention. First, Konoki et al. require significant manganese (Mn) stating with regard to carburization, "when steel material of the tube contains appropriate amount of Mn and Nb, carburization from the tube wall surface is effectively restricted and deterioration of tube material can be prevented." (Column 1, lines 47-61). Second, Konoki et al. recite that their invention offers a reactor tube whose reacting layer is made of Fe-Cr heat resisting steel free from Ni or composed of Fe-Cr-Ni heat resisting steel containing up to 10% of Ni (Col 1, lines 64-69 and Col 2, lines 1-3) where the reactor tube comprises up to 15% Mn (Col 2, lines 19-20) and where the reacting layer is covered by an outer layer made of the conventional material. (Col 2, lines 3-4). Thus, with respect to the reacting layer, Konoko et al. clearly teaches to reduce and minimize Ni percentage while maintaining "appropriate" Mn percentage, in order to reduce carbon deposition and carburization. More particularly, Konoke et al. teaches incorporating zero wt% Ni or, alternatively, up to 10% Ni

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in embodiments comprised of 6-15% Mn in low-nickel Fe-Cr-Mn-Nb-Ni heat resisting steel (Col 4, lines 18-20, and 26-32).

Contrary to the teaching of Konoki et al., Applicant discloses an embodiment in which the reformer material composition is substantially depleted in manganese (Mn), i.e., with Mn existing only as a potential impurity (see specification at page 4, line 12, 24; page 5, line 2; and claim 3). Second, also contrary to Konoki's teaching of zero wt% Ni or small wt% Ni in the presence of 6-15 wt% Mn, Applicant's method employs a higher percentage of Ni, i.e., 8-35% Ni in at least one embodiment and 8-14% Ni in at least one other embodiment (Applicant's specification at page 4, lines 23,34; page 7, line 9).

Since the reacting layer of Konoki et al. is a ferrite material comprising 20% or more of Cr and either containing no Ni or a small wt% of Ni in the presence of substantial wt% of Mn, such alloy is inferior to the present invention in the resistance to corrosion. Where Konoki et al. lose durability in the reacting layer by substantially reducing Ni percentage, Applicant maintains durability by maintaining 8-14 mass% Ni composition without need for a significant percentage of Mn. Where Konoki et al. lose protection against carburization and sigma brittleness in both reacting and covering layers owing to a higher 20-40 wt% Cr,

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Applicant improves protection against carburization and sigma brittleness by limiting Cr to 17-20 mass%.

Konoki et al. teaches that, in order to solve simultaneously (a) the need to resist brittleness caused by carburization in the material exposed to either the raw hydrocarbon fuel to be reformed or carbon-based combustion products, and (b) needs for strength, corrosion resistance and durability in the presence of high heat and oxygen, a two-component composition and two-walled construction is required. To solve the former problems of brittleness caused by carburization, Konoki reduces Ni and maintains a substantial percentage of Mn in the reacting layer. To solve the latter problem of corrosion caused by high heat Konoki increases both Cr and Ni in the outer covering layer. This teaching of Konoki et al. increases material cost, increases fabrication cost, increases wall thickness and adds weight, in that it requires fabrication of an inner-wall reacting layer firmly bonded within a contacting second "outer covering layer" of surrounding material.

Applicant, on the other hand, contrary to Konoki's teaching, discloses that the above material degradation challenges and other design goals can be solved with a reformer built of material of a single composition. Applicant's invention is not limited to a

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reactor tube where the reformer material comprises an inner-wall reacting layer firmly bonded to an enveloping "outer covering layer." (see Figure 3, Applicant's specification; page 9, lines 20-34; page 11, lines 6-25). Where Konoki et al. discloses requiring two walls, one of which is 18-40% Ni, thus increasing raw material cost and wall thickness, Applicant reduces material cost and wall thickness by the present invention of 8-14% Ni composition. As well, Applicant achieves lower fabrication costs and lighter weight.

Konoki et al. teaches improving the resistance to corrosion by using a covering layer that contains 20-30 wt% Cr and 18-40 wt% Ni; however, these contents are larger than those of the present invention. Applicant succeeds in resisting corrosion by employing 17-20% Cr and 8-14% Ni, without resort to a covering layer.

Therefore, the components and contents of the alloy in claim 3 of the present invention are different from those of said reacting layer and covering in Konoki et al. and are not taught by Konoki et al., which reference actually teaches away from Applicant's invention.

6. Examiner rejected claims 4 and 5 as being unpatentable over Sugitani et al. Applicant has canceled claims 4 and 5.

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SUMMARY

Applicant has responded to Examiner's rejections by canceling claims 1,2,4-6, and 8. Applicant has amended claims 3, 7 and 9 and has distinguished the claimed invention from the cited references. Applicant has amended the Abstract for form and length.

Therefore, allowance is hereby requested.

Respectfully submitted,

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